4. Deployment requirements:
   - ➢ Are there any special considerations or costs associated with integrating your system with the following infrastructures?
     - Ericsson GSM
     - Ericsson TDMA
     - Nortel GSM
     - Nortel TDMA
     - Lucent Series II
     - Lucent Flexent
   - ➢ Does this technology require any hardware or software modifications to the cell site?
   - ➢ Does this technology require any hardware or software modifications to the MSC?
   - ➢ If your system utilizes AOA, what is the impact if AOA antennas can not be installed? (Leasing, structural or zoning issues) in the following cell percentages:
     - 10% of cells without AOA antennas.
     - 20% of cells without AOA antennas.
     - 40% of cells without AOA antennas

   What MSC arrangements are required to install the field and switch hardware? Describe the field support and project management services provided for an initial installation and turn-up and the continuimg post installation support for the proposed system.

   - ➢ Who will install the hardware cell and switch hardware?

Pricing

1. Scenario #1 Assumptions
   - ➢ 5000 Cell Sites
   - ➢ 18 MSC in 9 States
   - ➢ 30% PSAP Request each year
   - ➢ Matching percentage of cells and MSC's to PSAP requests.
2. What is the firm pricing for all network components given the above assumptions? This should include, but not be limited to all system software, hardware, LMU's and miscellaneous installation hardware/cabling costs. Is there a standard configuration.
3. The system will be required to o support each of the technologies listed in item 1. Please list any charges beyond pricing in #2 and maintenance fees that would be required to support each of the technologies.
4. Please provide EF&I pricing for location network growth on a cell by cell basis.

System Performance and Monitoring

- ➢ Please describe the process by which your system can be monitored for performance and alarming. Please include in your response the following:
  - A description of any software required.
  - Alarm format and structure.

- Interconnect requirements.
- System interface capabilities with a network control center.
- Describe the network redundancy and provide information on MTF for all network components.
- A complete list of all available alarms.
- A location system will be required to be in compliance with the attached "Network Monitoring and Control" interface document. Describe your ability to meet those requirements. [NOTE THAT THIS NEEDS TO BE MADE INTO AN SBC OR "ALLOY" DOCUMENT, UNLESS WE JUST INCLUDE TEXT AS AN APPENDIX TO THE RFQ]

Performance Guarantees

- Your system must meet or exceed the current FCC requirements for E911. Note that we may require a Service Level Agreement and/or agree upon Liquidated Damages.
- If the FCC further tightens the location requirements, what is your guarantee that your system will meet and exceed any future tightening of the location requirements? What is the best accuracy that you feel your system can attain?
- Descrbe your escalation process and corrective action plan if a deployed system does not meet FCC requirements?
-

Service Bureau Request:

If your company offers a Service Bureau solution, please also complete the following section. The technical requirements from the previous section will apply to a service bureau environment, whether or not the system or some of its components are installed on ------------property. Please detail any differences from the non-service bureau environment.

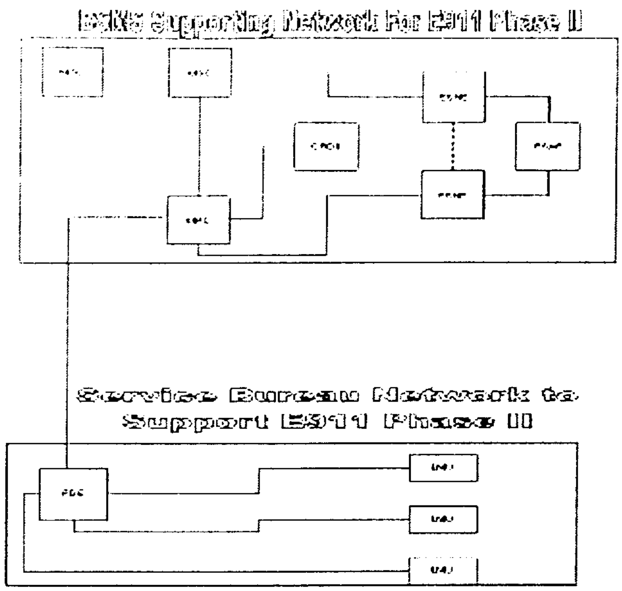
Network Configuration

1. Give an overview of your proposed service bureau product approach and related services and how they will satisfy our needs as outlined in this RFQ. Note all variances between your proposed service bureau product and the specified requirements.

2. Provide a detailed architectural description and network diagram for each proposed service bureau product and/or service arrangement, including appropriate drawings overlaid on the RFQ Current, Reference, and Planned network architectures. Responses should also include detailed information for each proposed product and/or service arrangement in the following areas: Service Components, Software Features and Dependencies, Physical connectivity, Service Provisioning Requirements, and Call Flow Diagrams,

3. BSMSG/SBC Preferred Network Configuration:
   It is BSMSG/SBC intent to deploy an MPC per market. This MPC will interface with the Market's MSC's and the regional PSAP's. Any Service Bureau (SB) solution must interface with this MPC.

[WE NEED TO EXPAND A BIT ON THIS – MUST INCLUDE HCAS]



- ➢ Please describe your network architecture using this approach.
- ➢ Highlight the signaling supported between your PDE and our MPC.
- ➢ Describe the system redundancy and routing diversity to minimize system outages.

Service Bureau Pricing

1. Assumptions
   - ➢ Use BSMSG/SBC preferred network configuration.
   - ➢ Total number of customers 6,000,000
   - ➢ Total number of Markets 18
   - ➢ Total number of PSAP's served ________
   - ➢ All scenarios are to be built into 3 and 5 year contract periods.
   - ➢ Please refer to the table below for estimates PSAP deployment schedules and estimated customers covered by these requests.

Calendar year	Year	% of PSAPs requesting Phase II	Percent of Customers Covered by PSAP Request
Q1/2000	2000.1	0	0%
Q2/2000	2000.2	0	0%
Q3/2000	2000.3	0	0%
Q4/2000	2000.4	0	0%
Q1/2001	2001.1	0	0%
Q2/2001	2001.2	0	0%
Q3/2001	2001.3	0	0%
Q4/2001	2001.4	0.05	15%
Q1/2002	2002.1	0.1	19%
Q2/2002	2002.2	0.15	24%
Q3/2002	2002.3	0.2	28%
Q4/2002	2002.4	0.25	33%
Q1/2003	2003.1	0.3	37%
Q2/2003	2003.2	0.35	42%
Q3/2003	2003.3	0.4	46%
Q4/2003	2003.4	0.45	51%
Q1/2004	2004.1	0.5	55%
Q2/2004	2004.2	0.55	60%
Q3/2004	2004.3	0.6	64%
Q4/2004	2004.4	0.65	69%
Q1/2005	2005.1	0.7	73%
Q2/2005	2005.2	0.7	73%
Q3/2005	2005.3	0.7	73%
Q4/2005	2005.4	0.7	73%

2. Pricing Scenarios
   - Pricing per subscriber covered by PSAP Requests
   - One time and recurring subsciber pricing
   - Pricing per subscriber on a market basis
   - Pricing per call located

3. Special Considerations
   - Special requirements for supporting GSM 1900MHz.
   - Special requirements for supporting TDMA operating at both 800 and 1900MHz.
   - The system will be required to o support each of the technologies listed in RFP Section 2. Please list any charges beyond pricing in #2 and maintenance fees that would be required to support each of the technologies.

System Availability and Rollout Schedules

5. Hardware Availability:

   What is your current production capacity for providing the systems/services described herein?

If orders were placed in March 2001 for TDMA800 capable systems, how long would it take to Engineer, Furnish & Install the following quantities?

- 100 Three Sector units:
- 200 Three sector units:
- 300 Three Sector units:
- 400 Three Sector units:
- 500 Three Sector units:
- 600 Three Sector units:
- 1000 Three Sector units:

If orders were placed inMarch 2001 for TDMA1900 capable systems , how long would it take to Engineer, Furnish & Install the following quantities?

- 100 Three Sector units:
- 200 Three sector units:
- 300 Three Sector units:
- 400 Three Sector units:
- 500 Three Sector units:
- 600 Three Sector units:
- 1000 Three Sector units:

If orders were placed in March 2001 for GSM 1900 capable systems , how long would it take to Engineer, Furnish & Install the following quantities?

- 100 Three Sector units:
- 200 Three sector units:
- 300 Three Sector units:
- 400 Three Sector units:
- 500 Three Sector units:
- 600 Three Sector units:
- 1000 Three Sector units:

DO WE NEED ONE OF THESE FOR GSM 800?

- BSMSG/SBCG/SBC is under a mandated to deploy Phase II solution based on PSAP requests. Please describe how your deployment schedules can be adjusted to meet PSAP requests in the following areas.
    - PSAP requests in an MSA Urban Areas.
    - PSAP requests in an MSA Suburban Areas.
    - PSAP requests in RSA Areas.
    - PSAP requests in BTA Areas.

Performance Guarantees

- What guarantee will you provide that your system will meet and exceed the current FCC requirements for E911?
- With the FCC suggesting a future tightening of the location requirements, what is your guarantee that your system will meet and exceed any future tightening of the location requirements?
- What steps will your company take if the deployed system does not meet FCC requirements?
- Is your company willing to assume all fines and penalties, including any punitive damages, resulting from your system failure to meet FCC mandates?

[ONLY NEED THIS ONCE]

Privacy and Ownership

Ownership of the BSMS/SBC customer's location data

Describe your methodology for processing and providing the location data to BSMS/SBC. Explain in detail any plans you have for storing, analyzing, or utilizing BSMS location information in any manner outside of the specific function of providing location data to BSMS/SBC.

[BSMS/SBC will want to maintain ownership of the customer's location information]

Privacy of the BSMS/SBC customer's location data

Privacy is anticipated to be a critical issue with location data. Describe your procedures for protecting and safeguarding the privacy of the BSMS/SBC customer's location data.

[Privacy is a huge concern; location data is CPNI data; ....]

Response Information

- Responses are to be received by BellSouth and SBC no later than August 30, 2000.
- Responses should be in electronic and hardcopy formats.
- All responses are to be delivered to both the SBC and BellSouth contacts listed below.

BellSouth	SBC
Andrew Clegg and Michael Heubel	Robert Tyler and Mark McAllister
404-249-3267 or 404-713-2035	
1100 Peachtree St. NE Suite 12D01 Atlanta GA. 30309	
Andrew_Clegg@bscc.bls.com Michael_Heubel@bscc.bls.com	Robert.J.Tyler@cellular.ameritech.com Mcallister@tri.sbc.com

ATTACHMENT D

ATTACHMENT D

Cingular Wireless

E911 Phase II Trial Results

Author	Andrew Clegg
Revision	3.1
Revision Date	7/5/01

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Contents

1. Summary

This document summarizes the results of trials of several E911 Phase II location technologies, including TDOA, AOA/TDOA, A-GPS, E-OTD, and RF Mapping systems.

The main conclusions are:

- Accuracy claims made by vendors are overstated because they do not incorporate confidence statistics in their analysis.
- In the Cingular trials, none of the technologies met the FCC accuracy mandate, whether or not confidence statistics are applied.

2. Introduction

This document summarizes the results of Phase II E911 location technology trials that have been conducted by BellSouth, SBC, and Cingular (the wireless components of BellSouth and SBC were combined in a joint venture in October, 2000, forming Cingular).

These trials are:

Technology	Vendor	Air Interface	Date of Trial(s)
TDOA	TruePosition	Analog	1999 May 6 – 7
Assisted GPS	SnapTrack	GSM	1999 December 13 – 17
RF Mapping	U.S. Wireless	TDMA & analog	2000 August 8 – 9
AOA/TDOA	SigmaOne	TDMA & analog	2000 August 15 – 16 2000 December 10 – 11
E-OTD	CPS	GSM	2000 July 30 – August 1 2000 October 8 – 9

2.1. References

FCC 00-326, Fourth Memorandum Opinion and Order, Revision of the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems (CC Docket 94-102), September 8, 2000

FCC OET Bulletin 71, Guidelines for Testing and Verifying the Accuracy of Wireless E911 Location Systems, April 12, 2000

2.2. Glossary

This section provides definitions for new and/or project-specific terms and acronyms used in this document.

Term or Acronym	Definition
A-GPS	Assisted GPS
AOA	Angle of Arrival
E911	Enhanced 911
E-OTD	Enhanced Observed Time Difference
GPS	Global Positioning System
MAHO	Mobile Assisted Handoff
PSAP	Public Safety Answering Point
TDOA	Time Difference of Arrival

3. Trial Purpose and Strategy

The purpose of the trials was to test the location accuracy and the yield (percent of calls located) of various location technologies, and to compare the results to the FCC's Phase II E911 requirements.

The basic test strategy was to make test calls at a set of geographic points that represented a variety of environments, and to compare the derived locations to ground truth data (accurate latitude and longitude) obtained from GPS or from professional land surveys. Statistical analysis of the difference between derived locations and ground truth data was used to determine the performance of the location technologies with respect to the FCC mandate.

In each trial, a small number of calls were made from a variety of challenging environments (typically indoors) that were designed to stress the capabilities of the location technologies. Generally, the data from those calls were used only as a general indication of the environments in which we might expect a successful location to be made. These calls were not included in the analysis of the location accuracies, unless specifically mentioned in the following trial summaries.

4. FCC Mandate

The FCC's accuracy requirement for Phase II location technologies is summarized in the following table:

Technology	Type	67% accuracy (90% confidence)	95% accuracy (90% confidence)
A-GPS	Handset	50 m	150 m
AOA	Network	100 m	300 m
E-OTD	Handset	50 m	150 m
RF Mapping	Network	100 m	300 m
TDOA	Network	100 m	300 m

4.1. Statistical Confidence

An important consideration in analyzing the test results has been uniformly overlooked by virtually every vendor, carrier, PSAP, and even, most of the time, by the FCC itself. FCC OET Bulletin 71, "Guidelines for Testing and Verifying the Accuracy of Wireless E911 Location Systems," states:

> Conclusions derived from test results should be stated for at least a 90 percent level of confidence. A 90 percent level of confidence means that performance can be expected to be at least as good in 9 out of 10 test areas with the same relevant characteristics. (OET Bulletin 71, Section V).

As far as Cingular is aware, all accuracy claims that have been furnished by vendors in press releases, in filings to the Commission, and in reports presented to Cingular, have consistently neglected to include statistical confidence. The result is that the quoted 67% and 95% accuracy claims are misleading because when statistical confidence is taken into account, the accuracy results become worse than the stated values.

As a practical example, consider a set of 100 test calls made at a single location. From this set of calls, a set of 100 errors is derived, representing the distance between the location derived by the location technology for each call, and the actual location derived from ground truth data. The 100 errors are then sorted, so that error number 1 is the smallest, and error number 100 is the largest. The common method of analysis used by location vendors has then taken error number 67 as the 67% accuracy level, and error number 95 as the 95% accuracy level. This method does not take statistical confidence into account, is not in conformance with OET Bulletin 71, and produces misleading results.

The proper analysis follows from the equation in Appendix A of OET Bulletin 71. Given *n* measurements, with the *n* corresponding errors ranked in ascending order, the following measurements represent the 67% and 95% accuracy with 90% confidence:

***N* (number of samples)**	**Error corresponding to 67% accuracy with 90% confidence**	**Error corresponding to 95% accuracy with 90% confidence**
10	Insufficient samples	Insufficient samples
25	Insufficient samples	Insufficient samples
50	41	50
100	74; 75	100; 99
250	181; 182; 184	246; 245; 244
500	349; 350; 351; 353; 358	489; 485; 484; 483; 482

Table 4.1.1: 90% confidence samples for various numbers of test calls

The interpretation of this table is as follows. If 50 test calls are made, and the location error for all 50 calls are sorted in ascending order of magnitude, then the 41st largest error will be the 67% accuracy figure with 90% confidence, and the 50th (i.e., the worst) error will be the 95% accuracy figure with 90% confidence.

The statistical distribution can be multi-valued at a particular confidence level, which is why some of the entries in the table are multi-valued. For example, if 100 test calls are made, the 74th largest error will be the 67% accuracy with 90% confidence, and the 100th largest (the worst) error will be the 95% accuracy with 90% confidence. Equivalently, a trade-off in the accuracy figures at the same 90% confidence can be made, so that the 67% accuracy is somewhat worse (the 75th largest error), when paired with a somewhat improved 95% accuracy (the 99th largest error).

Compare this proper statistical analysis with the common—and erroneous—analysis that would use (for 100 test calls) the 67th largest error as the 67% accuracy and the 95th largest error as the 95% accuracy. The proper values are the 74th largest error and the 100th largest error (or the 75th and 99th errors), respectively. *The erroneous values will be a significant underestimate of the actual errors derived with 90% confidence, especially for small sample sizes.*

Note that based upon the formula in Appendix A in OET Bulletin 71, the smallest number of test points from which 90% confidence levels can be drawn is 45. If fewer test points are acquired, no accuracy figures can be derived at the 90% confidence level.

When possible due to yield and sample size, three sets of 67%/95% accuracies are quoted for each trial in this document. The first set corresponds to the ubiquitous (and *erroneous*) method of using the 67th and 95th largest errors. These numbers are misleading in a statistical sense, but are included to facilitate a qualitative level of comparison with (erroneous) accuracies quoted in trials conducted by parties other than Cingular. We call these values the "Erroneous Accuracies."

The second set of accuracies correspond to the best 67% accuracy achieved at 90% confidence, with the corresponding reduction in 95% accuracy as discussed above. We call these values the "Best 67% Accuracies."

The third set of accuracies corresponds to the best 95% accuracy at the expense of the 67% accuracy (at 90% confidence). We term these values the "Best 95% Accuracies."

5. TruePosition

BellSouth tested the TruePosition TDOA system in BellSouth's Houston, Texas, market in May, 1999. Due to a court order, Cingular cannot disclose the results of the trial.

6. SnapTrack

SnapTrack utilizes an assisted GPS (A-GPS) location technology. SnapTrack functions by incorporating the basic components of a GPS receiver into a wireless handset. The receiver is assisted by data sent to the handset by the wireless network. The assistance data contains information about the signals from the GPS satellites, specific to the general area in which the handset is located. After acquisition of signals from multiple GPS satellites, the handset-based receiver performs rudimentary processing of the GPS data, and sends the data back to the wireless network. The network then processes those data, and computes a position for the wireless handset.

The assistance data allow the handset's GPS receiver to acquire the GPS satellite signals more quickly than a stand-alone GPS receiver, and it also allows the receiver to receive the GPS signals at a better sensitivity level compared to a stand-alone receiver. The increased sensitivity is supposed to allow A-GPS technology to work inside buildings and in other environments where standalone GPS receivers generally don't function.

6.1. BellSouth Trial of SnapTrack

SnapTrack's assisted GPS product was tested in BellSouth's GSM market in Charlotte, NC. The trial was performed during December, 1999.

To date, there are no TDMA or GSM handsets available that have incorporated a GPS receiver and antenna system, and, to Cingular's knowledge, none are planned. SnapTrack's product was tested by using a backpack-sized system that emulates the functions that would eventually be incorporated into wireless handsets.

The GPS antenna was a helix-type antenna, approximately one inch long by ½ inch wide. It was not similar to the small patch-type antenna that would be incorporated into a handset. It is expected that integration of the antenna into a handset would cause lower sensitivity than was achieved in the trial.

The assistance data were sent to the backpack using a circuit-switched data connection over BellSouth's GSM network, and the GPS data were sent back to the network using the same data connection.

The network infrastructure consisted of a reference GPS receiver whose antenna location was professionally surveyed in latitude, longitude, and elevation to an accuracy of a few centimeters. The hardware also included a PC that was used to generate the assistance data, and process the GPS data returned by the handset. The infrastructure was sufficient for covering the entire Charlotte metro area, and surrounding metro and rural areas out to a radius of more than 200 km. Due to logistical constraints, location tests were performed only within approximately 30 km of the central GPS reference site.

The general test strategy was similar to all location trials conducted by BellSouth, SBC, and Cingular. After the infrastructure was in place and the system calibrated by the vendor, test calls were made from a variety of environments throughout the test area. The areas from which the test calls were made represented areas from which emergency calls might be placed. In the SnapTrack trial, the following environments were tested: outdoor urban, outdoor suburban, in-vehicle stationary, in-vehicle moving, indoor urban, indoor suburban, shopping mall, hotel room, parking garage, underneath an overpass, inside a wood-frame home, at an airport departure gate, and inside a movie theatre.

A total of 1328 test calls were made from 19 different locations.

6.2. Outdoor Performance

The GPS system is optimized for outdoor coverage, and it was expected that the SnapTrack A-GPS technology would perform well outdoors. Generally, this assumption was proven correct for the majority of the calls.

The outdoor yield of the SnapTrack system was good: 470 out of 481 calls (97.7%) were detected and located. The majority (7 of 11) of the calls that were not located were from a single location in downtown Charlotte.

The best locations were very accurate—nearly one third of the outdoor test calls were located to an accuracy better than 10 m, and over 75% of the calls were located to an accuracy of better than 30 m. However, like other location technologies, the performance fell off rapidly at the higher levels of the distribution function. For example, nearly 10% of the calls had accuracies worse than 300 m, and 15 of the calls were worse than 1000 m.

The Best 67% accuracy figure (90% confidence, corresponding to the 336th largest error) was 23.4 m for outdoor calls, but a corresponding 95% accuracy cannot be derived due to insufficient yield (the sample corresponding to the 95% accuracy with 90% confidence is one of the samples for which no location was returned).

The Best 95% accuracy figure (90% confidence) was 1770 m, with a corresponding 67% accuracy (90% confidence corresponding to Best 95% result) of 23.9 m.

The Erroneous 67% and 95% accuracy figures (the 323rd and 457th largest sample errors) were 20.8 m and 1081m, respectively.

6.3. Indoor Performance

The SnapTrack system was tested in a variety of indoor environments, including a restaurant, a hotel room, a movie theatre, a shopping mall, and a parking garage. While we expected the system to perform well outdoors, we also expected to see impressive results indoors, compared to standalone GPS receivers.

The indoor trial results for SnapTrack were, however, disappointing. Generally, the system produced low (or no) yield when indoors, especially when more than approximately 5 m from a window. Across all indoor environments, the yield was 602 out of 847 (71%). The indoor accuracies for calls that were located ranged from 2 m to 1010 m. The Best 67% accuracy (90% confidence, the 586th largest error) was 256 m. The Erroneous 67% accuracy was 180 m. The yield was insufficient to determine any 95% accuracy figures.

6.4. Overall Performance

The overall yield of the SnapTrack location system in the BellSouth tests was 1072 out of 1328 calls, or 81%. This fraction is sensitive to the relative percentages of indoor and outdoor calls, since the outdoor performance was, as expected, very good. BellSouth was especially interested in the indoor performance, and therefore conducted a greater number of test calls indoors, and the overall yield reflects this.

Based on the total set of test calls, the Best 67% accuracy (the 913th largest sample error) was 76 m. The Erroneous 67% accuracy (the 890th largest sample error) was 67 m. The yield was insufficient to determine any 95% accuracy figures.

6.5. Cumulative Distribution Functions

The cumulative distribution functions for the SnapTrack test calls are presented in Appendix A of this document.

7. U.S. Wireless

U.S. Wireless manufactures the "RadioCamera" location technology. RadioCamera uses the multipath signature of the handset signal as received at the base station to compute a location. The system essentially fingerprints the pre-calibrated coverage area by way of extensive drive testing, so that each multipath signature can be translated into a likely x-y coordinate. RadioCamera requires the installation of reception equipment, including a small antenna array, at each base station in the network.

RadioCamera is optimized to work in urban environments because the multipath signatures are most distinct in areas where there are multiple reflective structures. The performance of RadioCamera is expected to fall off in rural areas, where the number of multipath components is less. BellSouth, SBC, and Cingular have not tested RadioCamera in a rural or suburban environment.

RadioCamera requires extensive calibration in order to work. The multipath signature cannot be reliably interpolated or extrapolated beyond a distance of a few tens of meters. U.S. Wireless calibrates their systems along routes where tests are conducted, and does not guarantee that their system will perform with any specific accuracy off of those calibrated areas. As a consequence, for example, the system could be calibrated by driving around a city block, and the system would be expected to work reasonably well along the streets used to perform the calibration, but could not be relied upon to work well inside a park bounded by the drive route.

If Cingular deployed the RadioCamera technology, it would have to drive test every street (urban, suburban, and rural) in every market of every region of its wireless coverage to calibrate the RadioCamera system. The system would still not necessarily perform well off the streets used for calibration.

Cingular tested RadioCamera in the counties of Arlington and Alexandria in northern Virginia, in the suburbs of Washington, D.C. The system was installed in the Rosslyn area of Arlington, which is a moderate-sized business district consisting of many tall (>20 story) office buildings. In Alexandria, the system covered a light urban area, and a strip of I495 (the Capitol Beltway). The U.S. Wireless equipment was installed in 6 base stations in Alexandria and 6 base stations in Arlington.

Before the start of testing in this trial, U.S. Wireless carefully calibrated their system along every path that they expected us to use. They drove test essentially every street in Rosslyn and Alexandria, and along the Beltway. To a limited extent, and against the desire of U.S. Wireless, Cingular was able to test the system in locations that were off the calibrated drive route, but still within the RadioCamera coverage area. We refer to data collected along the drive route as "On-Grid" data, and data collected more than approximately 30 m off the calibration route as "Off-Grid" data. All points (both on and off grid) were outdoors, and still within the coverage area of the RadioCamera receivers.

7.1. On-Grid

The RadioCamera system was tested on-grid by driving the same routes that had previously been calibrated by U.S. Wireless. The data were collected in a manner that did not allow a determination of yield, as the test setup included a device that independently alerted the network-based infrastructure that a test call had been made. Essentially, a stream of test calls was acquired during the course of driving the routes. A total of 7703 separate locations were derived. Because of the large number of test points, confidence statistics are not applied—"Erroneous" values, the "Best 67%" values, and the "Best 95%" values are essentially the same. These numbers are: 67% accuracy, 90.7 m; 95% accuracy, 1096 m.

7.2. Off-Grid

The off-grid data was obtained by moving more than approximately 30 m off the calibrated routes, typically by moving the phone to a nearby park or sidewalk. The statistical performance was significantly degraded: 67% accuracy was 210 m; the 95 % accuracy was 1411 m. No confidence statistics were used due to the large sample size (6030 test calls).

7.3. Cumulative Distribution Functions

The cumulative distribution functions for the U.S. Wireless data are shown in Appendix A of this document.

8. SigmaOne

SigmaOne manufactures a TDOA/AOA based location technology system. It is similar in function to the TruePosition system, but SigmaOne included an AOA component in all of the sites used for the trials. The AOA component required additional antennas at the base station sites.

Cingular has tested SigmaOne's technology in the San Antonio market. Seven base stations were equipped with SigmaOne location equipment. The equipment was first installed in an urban area, near the Riverwalk section of downtown San Antonio, and then it was installed in a rural setting outside of the city. The rural trial utilized eight base stations equipped with the location units. The urban trial was conducted in August 2000, and the rural trial was conducted in December 2000.

For the urban trial, Cingular has not obtained the raw location data. Consequently, only the "Erroneous" accuracy figures can be determined, as reported by SigmaOne, with no confidence statistics applied. In both the urban and rural trial, the yield cannot be determined, as only successful location data were provide by SigmaOne.

As with the other technology trials, test calls were made from a variety of environments. No indoor calls were placed, with the exception of approximately 10 calls that were made from just inside the doors of a convention center in the urban trial.

8.1. Urban Trial

Test calls made in urban San Antonio produced the following statistics, as reported by SigmaOne: Erroneous 67% accuracy, 96 m; Erroneous 95% accuracy, 132 m. Because Cingular does not have access to the individual data points, it is not clear if these numbers represent statistics on only those calls that were located, or on all calls, whether or not they were located.

8.2. Rural Trial

A total of 557 successfully located test calls were made in the rural area near San Antonio. The Best 67% accuracies were 247 m 67% (sample 388) and 695 m 95% (sample 542). The Best 95% accuracies were 254 m 67% (sample 393) and 613 m 95% (sample 537). The Erroneous accuracies are 235 m 67% (sample 374) and 505 m 95% (sample 530).

8.3. Summary Result

Without additional information on the number of calls and the distribution of the errors, Cingular is unable to determine a true overall performance factor for the SigmaOne system. Consequently, the overall performance statistics will be calculated by averaging the

Erroneous accuracies for the rural and urban trials. The Erroneous accuracies derived in this manner are: 166 m 67% and 319 m 95%.

9. Cambridge Positioning Systems

Aerial/VoiceStream invited BellSouth and SBC to observe a trial of E-OTD technology in the Houston market. The E-OTD system was installed by Cambridge Positioning Systems (CPS), the sole OEM of E-OTD technology.

E-OTD requires the handset to perform time of arrival measurements of the signals from multiple surrounding base stations. E-OTD is essentially a downlink version of TDOA. E-OTD requires the handsets to be modified to support the high-resolution timing measurements. Initially it was believed that legacy handsets could be flash upgraded with new software to support this feature, but this assumption has proven to be false.

For the Houston trial, CPS worked with Mitsubishi to create a few prototype handsets to support E-OTD. Because of a variety of issues, including the processing power of the handsets, limitations of the CPS network infrastructure, and the development of the E-OTD technology itself, significant restrictions were placed on the methods of testing. The following restrictions applied during the three phases of the test in which Cingular participated:

- Phase 1: Phone in idle-mode only (no call in progress), and stationary for at least 3 minutes before testing.
- Phase 2: Phone in idle-mode only, motion allowed
- Phase 3: Phone in dedicated-mode (call in progress), but stationary for at least 3 minutes before testing

Note that Cingular never observed E-OTD functioning for a phone in dedicated mode and in motion. CPS indicated that the phones had clock problems that did not allow dedicated mode/motion testing, and that they would exhibit this capability at a later time. However, the trial was terminated before Cingular observed this capability.